Ciara Moynagh
17340087

The Work and Impact of Kathleen Antonelli

"The Irish Mother of Computer Programming" – The Irish Times (2019)

The software engineer whom I have chosen to discuss is Kathleen Antonelli, one of the original six programmers of the Electronic Numerical Integrator and Computer (ENIAC)- the first electronic digital general-purpose computer. I find her story particularly captivating as she was an Irish-born female, brought into the world at a time when there were not many prospects for women in the tech industry. Despite this, she went on to become one of the first female software engineers. Although she did not receive any recognition for her transformative work for years, she helped prove it possible for a woman to be an accomplished programmer, whilst simultaneously raising a large family. As a woman in the same industry, I find her story captivating and inspiring, and see her as a wonderful role model for any young girl looking to dive into STEM.

Early Life

Kathleen 'Kay' McNulty was born on February 12th, 1921, in the quaint village of Creeslough, in the Gaeltacht area of County Donegal. She was born in the height of the Irish War of Independence, and on the evening of her birth, her father- an IRA training officer- was arrested and imprisoned for two years in Derry Gaol. When released in October of 1924, the family migrated to and settled in Philadelphia, Pennsylvania, USA.

This move held great opportunities for Kay. In the 1920's, roughly 35% of girls in Ireland aged 14-16 were enrolled in a school. However, living in Philadelphia, Kay was not only granted the opportunity to attend primary and secondary school, but received a brilliant third level education- a luxury that most Donegal girls could only dream of. Excelling in her school studies, Kathleen won a scholarship to Chestnut Hill College for Women. Here, she took part in every maths course that the college had to offer- spherical trigonometry, statistics, partial differential equations, differential calculus, and projective geometry- to name but a few. She remembers her mother encouraging her to do her very best and to work her very hardest- *"to prove that Irish Immigrants could be as good, if not better, than anybody"* (The Irish Times, 2019).

Work & Impact

In June of 1942, Kathleen graduated with remarkable grades and a degree in mathematics-

one of only 3 maths majors out of a class of 92 women. She graduated at the height of World War II, and because of this, quickly acquired a job at the Moore School of Electrical Engineering, University of Pennsylvania, with the US Civil Service. Here Kathleen became a highly notable employee in her roll, which involved computing ballistics trajectories used in artillery firing tables- central to the American war efforts. It was slow, painstaking work, achieved mostly by use of mechanical desk calculators and ginormous sheets of columned paper. Her official job title was 'Computer', as printed on her employment documentation. To quote Antonelli- *"We did have desk calculators at that time, mechanical and driven with electric motors, that could do simple arithmetic. You'd do a multiplication and when the answer appeared, you had to write it down to re-enter it into the machine to do the next calculation. We were preparing a firing table for each gun, with maybe 1,800 simple trajectories. To hand-compute just one of these trajectories took 30 or 40 hours of sitting at a desk with paper and a calculator. As you can imagine, they were soon running out of young women to do the calculations."*

An engineer at the school by the name of J Presper Eckert realised that the analogue machines could not keep up with the pace necessary for the American war efforts. He drew the conclusion that an electronic computer- rather than a human computer- was the answer. Himself and a fellow engineer by the name of John Mauchly began to work on the basic idea for the ENIAC.

As a highly accredited member within her team, Kathleen was soon chosen by Eckert and Mauchly, along with five of the other best women 'computers', to move workplace to the Aberdeen military base, Maryland. Here they would develop the processor for a top-secret 30 tonne machine, known as the Electronic Numerical Integrator and Computer- the ENIAC. This mammoth computer did not have any memory for holding instructions on how to perform calculations. Instead, it had to be programmed by hand by Kathleen and her five colleges. The women essentially taught themselves how to program, with nothing but wiring diagrams to work with. They devised paradigms and methods to write complex software without any guidance or previous experience.

The development of the ENAIC was a major step forward in technology. It had a speed on the order of 1000 times faster than that of the electro-mechanical machines being used at the time. To calculate a trajectory which would have taken Kay 30-40 hours by hand, it required 30 seconds. Within a few years of its development, computers were popping up at banks, government agencies, universities and insurance companies. As stated by Kathleen- *"the ENIAC made me, one of the first 'computers', obsolete".*

The development of this computer built the foundations for the modern electronic computing industry. It demonstrated that high-speed digital computing was possible using the vacuum tube technology that was available at the time. It was built out of 17,468 electronic vacuum tubes, and was, at its time, the single largest electronic apparatus in the world. The ENIAC was the only fully electronic computer running in the United States for five years. It has been estimated that by the time it was retired in 1955, it had completed more calculations than all human beings had in all of history. As you may imagine, programming the ENIAC was a very difficult, demanding and contemporary profession.

Despite all the brilliant work and laborious hours that Kay and her five fellow programmers invested when developing this outstanding machine, they received no recognition when it was publicly launched in February of 1946. The six women were asked to act as hostesses, *"to greet all the big shots and show them around"*. To act as *"refrigerator ladies"*, standing beside the machine, smiling, looking good (The Irish Times, 2019). The six women that had made this fabulous new technology possible did not receive any credit or recognition for their work, for decades.

Kay left employment when she married John Mauchly, co-inventor of the ENIAC, in 1948, as was expected at the time. While on their honeymoon, Mauchly gifted Kay with a cookbook, and the words *"You are our new cook"* (The Irish Times, 2019).

John and Kathleen moved to a large farmhouse called Little Linden in Amber, Pennsylvania, where they had five children together. Kathleen raised these children, along with two others from Johns previous marriage. Throughout their life as a couple, Kay continued to program the new computers that her husband developed, including the BINAC (Binary Automatic Computer) and the UNIVAC (Universal Automatic Computer), without any recognition or pay.

In 1997, Kay and the other five ENIAC female developers were inducted into the Women in Technology International Hall of Fame. In 2010, a documentary was released, called "Top Secret Rosies, the Female *"Computers" of WWII".* This piece is based around in-depth interviews with the three living ENIAC programmers, focusing on recognising their patriotic contributions throughout WWII.

When discussing her career in an interview in 2014, Kathleen reflected: *"All the years I gave talks about the ENIAC, I always talked about it as John's story, not my story".* She was invited to these talks to speak on her late husband's behalf as the co-inventor of the ENIAC, and not on her own right, as one of the original six programmers of the world's first electronic general-purpose computer.

Antonelli died of cancer in Wyndmoor, Pennsylvania, on April 20th, 2006, at the age of 85.

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